
Rule CIC425: Coupling Facility Data Table list structure was out of space

Finding: The CICS Coupling Facility Data Table (CFDT) list structure statistics showed that the CFDT pool list structure was out of space.

Impact: This finding has a MEDIUM IMPACT or HIGH IMPACT on the performance of the CICS region.

Logic flow: This is a basic finding, based on an analysis of the data. The finding applies only with CICS/Transaction Server for OS/390 Release 1.3, or for z/OS.

Discussion: Coupling Facility Data Tables are kept in a *named pool* in an MVS coupling facility. There can be multiple CFDT pools, each containing one or more CFDTs. Each CFDT pool is defined, using MVS cross-system extended services (XES), as a *list structure* in a coupling facility.

A list structure consists of a set of lists and an optional lock table of exclusive locks (which can be used to serialize the use of lists, list entries, or other resources in the list structure). Each list is pointed to by a *list header* and can contain a number of *list entries*. With CFDT pools, the list structure is the CFDT pool, while the lists themselves are CFDTs within the CFDT pool.

The CFDT pool server allocates the list structure based on parameters that are provided to the CFDT pool server at startup. These parameters allow a user to specify controls in such areas as allocation, security, tuning, reserved space, etc. Two parameters control the size of the CFDT pool:

- The MAXTABLES parameter provided to the CFDT pool server specifies how many tables can be in the CFDT pool list structure. The default value for the MAXTABLES parameter is 1000, indicating that 1000 tables can be opened in the CFDT pool.
- The POOLSIZE parameter specifies the initial amount of coupling facility storage to be allocated for the pool list structure. IBM recommends that a value not be specified for the POOLSIZE parameter, which allows the server to obtain an initial allocation using the parameters specified in the Coupling Facility Resource Management (CFRM) policy.

CICS automatically creates a CFDT within the CFDT pool when the first reference to the associated VSAM (KSDS) data set requires the CFDT to be opened. Once the CFDT is created, CICS can optionally load the

coupling facility data table automatically from a source VSAM data set when it is opened, or the file definition can specify that there is no associated source data set, allowing an empty CFDT to be created.

The XDTRD global user exit can be used to limit the records that are placed in the CFDT during *initial loading* of the CFDT. The XDTAD global user exit program can be used to limit the records that are *added to the CFDT as a result of a WRITE request* issued to a data table. Both these user exits can use screening criteria appropriate to the applications sharing the data.

The MAXNUMRECS parameter provided with the VSAM file definition specifies the maximum number of records that can be in the CFDT itself. The default value for the MAXNUMRECS parameter is NOLIMIT, indicating that there is no limit on the maximum number of records.

A CFDT pool list structure can become full if (1) a large VSAM source data set is loaded into a CFDT, exhausting all structure space; or (2) applications continue to write records to a CFDT, exhausting all structure space.

If the CFDT list structure is allowed to become completely full, message DFHCF0442 (*CF structure strname request failed, structure is full*) is issued and CICS rejects any attempt to add new records to a CFDT or to create new tables in the pool. Additionally, completely filling a CFDT list structure can have a significant impact on performance and application function. IBM gives the following examples of problems that occur when a CFDT pool list structure becomes full:

- Rewrite requests can be rejected even when the size of the new data is less than or equal to the original size.
- Server internal operations can fail, causing internal time-outs and retries.
- An attempt to close a table or change the table status could encounter a structure full condition. In this case, the attempt is retried indefinitely, because it must be completed in order to preserve table integrity (the only alternative would be to terminate the server). The retry process normally succeeds quickly, but there is a theoretical case where this can cause a loop until another server causes temporarily unavailable resources to be released.
- Rewrites with the same (or smaller) data size for a table using the contention update model are retried indefinitely if they initially fail because of a structure full condition. This is done to protect the application against having to handle this unexpected form of failure.

Again, the retry should normally succeed quickly, but there is a theoretical possibility that this could loop for a while.

- Rewrites for a table using the locking or recoverable update model could be rejected with a structure full condition even if the data size is not increased. No retry is attempted in this case.
- Units of work can be backed out because the server is unable to create unit of work control entries for commit processing.
- There may not be sufficient structure space to send lock release messages, in which case waiting tasks are not woken up immediately but continue to wait for up to the time-out interval specified on the LOCKWAITINTERVAL parameter before finding out that the lock has been released.

CFDT pool server startup parameters (ELEMENTRESERVEMIN, ELEMENTRESERVEPC, ENTRYRESERVEMIN and ENTRYRESERVEPC) are provided to reduce the risk of the structure becoming totally full. These parameters reserve a number of entries and elements in the list structure. These can be used only for operations that normally need extra space temporarily, such as rewrites or unit of work control operations.

The number of entries or elements *remaining* in the list structure is returned by each coupling facility access request. If a CFDT pool server is requested to write a new record or create a new table when the space remaining is less than or equal to the specified reserve level, the request is rejected¹ with an indication that no space is available.

Using the reserved space parameters means that, even if the structure fills up very rapidly (for example, because a table is being loaded that is too large for the available space), enough space should remain to allow rewrites of existing records and allow internal communication between servers to continue normally.

This mechanism cannot prevent the structure from eventually becoming totally full, as recoverable rewrites are allowed to use the reserved space temporarily, and rewrites that increase the data length will gradually use up the reserved elements.

CFDT list structure statistics for the coupling facility are available in MXG file CICCFS6D. CPExpert uses data in CICCFS6D to determine whether a Structure Full condition occurred for a CFDT pool server list structure.

¹ Before rejecting the request, the server issues a dummy read request in order to find out the latest usage levels for the structure, in case more space has recently become available.

CICCF6D variable S6RSP7CT (List structure became full) indicates that the list structure was full.

CPEXpert produces Rule CIC425 when the number of Structure Full conditions is greater than the value specified by the **CFNOSPCE** guidance variable in USOURCE(CICGUIDE). The default value for the **CFNOSPCE** is 0, indicating that CPEXpert should produce Rule CIC425 whenever any Structure Full conditions occurred.

Suggestion: If this finding is produced, you should consider the following alternatives:

- Review the STRUCTURE parameter and INITSIZE parameter in the CFRM policy to determine whether these parameters should be increased.
- Review the *Automatic ALTER parameters* to determine whether these parameters provide sufficient control over the conditions under which the CFDT server attempts an automatic ALTER action when the structure becomes nearly full.
- Review the CFDTs in the pool to see whether any have reached an unreasonably large number of records. Recall that the default value for the MAXNUMRECS parameter is NOLIMIT, indicating that there is no limit on the maximum number of records. A looping application (or one which otherwise generated an unexpectedly large number of records) can flood a CFDT pool with a large number of records. Perhaps a limiting value should be specified for the MAXNUMRECS parameter for any table with an unexpectedly large number of records.
- When a CFDT is loaded, it becomes an independent entity, separate from the behavior of the CICS regions that access the table or caused the table to be loaded. Even when all CICS regions have terminated, either normally or abnormally, a CFDT continues to remain in the coupling facility until explicit action is taken to delete the CFDT's list structure.

The CFDT contents or list structure can be deleted with a *MODIFY cfdt_server, DELETE TABLE=name* command. Procedures should be reviewed to ensure that any coupling facility data table which is no longer in use (or planned to be in use shortly) is deleted as soon as possible, so that the space can be reused.

- Determine whether the XDTRD user exit has been used for the CFDT. If the XDTRD user exit has **not** been used, consider adding the XDTRD user exit and devising appropriate screening criteria to be applied to the

VSAM KSDS records as they are read by CICS during initial loading² of the table. If the XDTRD user exit **has** been used, consider revising the screening criteria in the user exit to exclude a larger number of records during loading.

- Determine whether the XDTAD user exit has been used for the CFDT. If the XDTAD user exit has **not** been used, consider adding the XDTAD user exit and devising appropriate screening criteria to be applied to records as they are written to the CFDT. If the XDTAD user exit **has** been used, consider revising the screening criteria in the user exit to exclude a larger number of records during loading.
- Message DFHCF0446 (*CF structure strname free space is below reserve level. New records will be rejected.*) will be issued if the coupling facility data table server has detected that the number of free list entries or data elements in the pool structure has fallen below the reserve levels specified by the server parameters ENTRYRESERVEMIN, ENTRYRESERVEPC, ELEMENTRESERVEMIN and ELEMENTRESERVEPC.

Once this message is issued, any request to create a new record or table in the pool will be rejected for as long as the amount of free space remains below the reserve levels. The failing request is given a NOSPACE indication if it originated from a CICS API request.

Consequently, you should verify that the reserved space parameters (ENTRYRESERVEMIN, ENTRYRESERVEPC, ELEMENTRESERVEMIN and ELEMENTRESERVEPC) have not been specified with values that are too large.

- Change the CFNOSPCE guidance variable in USOURCE(CICGUIDE) so Rule CIC425 is produced only when you wish to be aware of a larger number of Structure Full situations. This alternative is **not** recommended! You should always be aware of Structure Full situations.
- You can “turn off” the rule using the process described in Section 3 of this User Manual. However, this alternative is **not** recommended! You should always be aware of Structure Full situations.

Reference: CICS/TS for OS/390 Release 1.3
CICS System Definition Guide: Section 2.10.8 (Coupling facility data tables)

CICS/TS for z/OS Release 2.1
CICS System Definition Guide: Chapter 27 (Starting a CFDT server)

²Of course, this alternative would not apply if a blank CFDT were created.

